CONSTRUCTION OF DIKE DISPOSAL SITES IN LAKE ERIE[1]

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Prior to 1970, the dredge spoil materials, mainly sand, silt and mud, were disposed of in the most convenient and economic fashion, in nearby waterways, adjacent wetlands, or nearby uplands. In the Great Lakes area open-lake dumping was the most widely practiced disposal method. During the late 1960's, state and federal pollution control agencies, as well as the public in general, became increasingly concerned about the environmental impact of the dredged material, particularly, but not totally, in regard to the deteriorating water quality of the Great Lakes. In response to this public concern, the Army Corps of Engineers, in cooperation with the U.S. Environmental Protection Agency, initiated an investigation into the whole dredge disposal problem on the lakes. This study covered a 2 year period and cost about 8 million dollars, but for the first time in the dredging history of the Great Lakes some definite data were produced. This study showed that, based on classical parameters used to characterize pollution of municipal and industrial wastes, many of the Great Lakes harbors were grossly polluted. All of the harbors within the boundaries of Ohio (11 in number) maintained by the Corps of Engineers were declared polluted by the Environmental Protection Agency (U.S. Corps Eng., 1969).

As an outgrowth of that study the United States Congress incorporated into the Rivers and Harbors Act of 1970 (Public Law 91-611) the mechanism for an action program to prevent further pollution of the Great Lakes originating from the harbor dredging program. Section 123 of that law authorizes the Secretary of the Army, acting through the Chief of Engineers, U.S. Army Corps of Engineers, to construct, operate, and maintain contained spoil disposal facilities at harbors where the dredged material is considered polluted by the U.S. Environmental Protection Agency (EPA) standards and likely to further degrade the water quality of the lakes if open-lake disposal is continued. The disposal facilities were designed with sufficient capacity for a period not to exceed 10 years. Non-Federal interests (i.e. port authorities, cities, etc.) were required to pay 25% of the cost of construction and provide the necessary lands, easements and rights-of-way. A waiver of the 25% local share may be granted by the Corps of Engineers, if the EPA recommends such a waiver should be granted, based on community progress in water pollution abatement.

U.S. EPA CRITERIA

The final decision on the degree of pollution and the necessity to confine the harbor dredge material rests with the U.S. EPA. The criteria for determining acceptability of dredged spoil disposal to the nation's waters was summarized as follows: (U.S. EPA, 1974).

The decision whether to oppose plans for disposal of dredged spoil in U.S. waters must be made on a case-by-case basis after considering all appropriate factors, including the following:

a. Volume of dredged materials
b. Existing and potential quality and use of the water in the disposal area
c. Other considerations at the disposal site such as depth and current

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[2]Presidential address presented at the 85th Annual Meeting of The Ohio Academy of Science held at Miami University, Oxford, Ohio, on April 23, 1976. Ralph J. Bernhagen, retiring president of The Ohio Academy of Science, has made many contributions to the state of Ohio during his tenure in the following positions in the Ohio Division of Natural Resources: Assistant State Geologist, Ohio Geological Survey; State Geologist and Division Chief, Ohio Division of Geological Survey; Division Chief, Water Planning Section; and Geology Program Supervisor, Ohio Division of Water.

d. Time of year of disposal (in relation to fish migration and spawning, etc.)
e. Method of disposal and alternatives
f. Physical, chemical, and biological characteristics of the dredged material
g. Likely recurrence and total number of disposal requests in a receiving water area
h. Predicted long and short term effects on receiving water quality

When concentrations, in sediments, of one or more of the following pollution parameters exceed the limits expressed below, the sediment will be considered polluted in all cases and, therefore, unacceptable for open water disposal.

Sediments in Fresh and Marine Waters	Conc. % (dry wt. basis)
Volatile Solids	6.0
Chemical Oxygen Demand (C.O.D.)	5.0
Total Kjeldahl Nitrogen	0.10
Oil-Grease	0.15
Mercury	0.0001
Lead	0.005
Zinc	0.005

In addition to the analyses required to determine compliance with the stated numerical criteria, the following additional tests were recommended where appropriate and pertinent: Total Phosphorus, Total Organic Carbon (T.O.C.), Immediate Oxygen Demand (I.O.D.), Settleability, Sulfides, Trace Metals (iron, cadmium, copper, chromium, arsenic, and nickel), Pesticides and Bioassay.

For more than a hundred years the U.S. Army Corps of Engineers has been building and maintaining the harbors and channels of the waterways of the United States. Annually, some 400 million cubic yards of sediment are dredged in order to maintain an appropriate navigation depth in literally thousands of miles of our navigable waters. In the Great Lakes area, the nation's fourth coastal zone, about 10.8 million cubic yards of material are dredged each year. Of this volume, more is removed from the Lake Erie coastal zone than all others combined. Approximately 6.7 million cubic yards are dredged from Lake Erie channels annually (table 1); 1.9 million from Lake Michigan; 1.0 million from Lake Huron; 500,000 from Lake Ontario; 400,000 from Lake St. Clair and the St. Clair River; and 300,000 from Lake Superior. (U.S. Corps Eng., 1969, Vol. 1, pg. 4.9–4.10).

STATUS OF OHIO HARBOR DREDGING PROJECTS (Table 2)

TOLEDO HARBOR

Maintenance dredging of the Toledo Harbor is performed annually throughout its 25 mile length which encompasses

TABLE 1

Average volume of material removed annually from Lake Erie harbors, 1960 to 1970.

Harbor	Cu. yards removed	% polluted cu. yards	Present disposal method
Conneaut	115,000	15%	Open-lake dumping
Ashtabula	130,000	35%	Open-lake dumping
Fairport	390,000	*	Open-lake dumping
Cleveland	1,270,000	100%	Diked Disposal Site 12
Rocky River	5,000	100%	To Cleveland site
Lorain	185,000	100%	Open-lake dumping
Vermilion	8,000	100%	To Huron Site 1976
Huron	200,000	100%	New Diked Disposal Site
Sandusky	500,000	63%	In 1976 and 77 to Huron Site
Port Clinton	15,000	*	Open-lake dumping
Toledo	1,290,000	100%	Open-lake; New Diked Disposal Site, July 1976

*Marginal to clean=0% polluted.

7 miles of channel upstream from its mouth and 18 miles to deep water in Lake Erie. A major portion of its total length is maintained at an authorized depth of 28 feet (U.S. Corps Eng., 1974).

In 1968 polluted sediments were found in about 12 miles of the upstream portion of the channel. Unpolluted sediments occurred in the channel beginning 5 miles from the mouth of the river and were similar to the lake bottom materials. Resampling in 1975 and 1976, however, shows that most of the material beyond mile five is now polluted and will require confinement when dredged.

The major portion of the sediments was derived from river bank and land sheet erosion and carried by the Maumee River and deposited where the current is decreased. As characterized by all the harbor sediments, contaminants in solution and suspension can be attributed to partly treated domestic and industrial wastes, agricultural by-products derived from fertilizers, pesticides, and animal wastes, urban storm water runoff, and wastes from small craft and deep-draft vessels utilizing the waterway and adjacent areas.

The new Toledo Harbor diked disposal facility, 2 years in construction, is a rubble mound structure comprising a total of approximately 2.5 miles of dike and encompassing 242 acres at the mouth of the Maumee River (figure 1). Nearly 1.8 million tons of stone of 7 different sizes and mixtures and 400,000 tons of clay-type material make up the structure (figure 2). This facility has a capacity of 12.9 million cubic yards, sufficient to accommodate the volume anticipated during a 10 year period.

Prior to July 1976, the unpolluted dredged material was disposed in the outer Maumee Bay about 12 miles lakeward of the mouth of the river, while the polluted material was deposited at a 150 acre island disposal area located on the left side of the channel at the mouth of the river. This disposal island (No. 18) will accommodate the early 1976 dredge material before being completely filled. Construction on the new disposal site is scheduled to be completed in July 1976,

TABLE 2.

Ohio program of Lake Erie harbor dredge disposal sites.

Harbor	Site and status	Size (acres)	Capacity cu. yds.	Construction		Appx. cost
				Start	Finish	
Conneaut	Cancelled 10/22/74	—	—	—	—	—
Ashtabula	Site selection in abeyance	—	—	—	—	—
Fairport	Site selection in abeyance	—	—	—	—	—
Cleveland	Site 12 Rubble Mound	60	2,680,000	9/73	6/75	$ 7,565,000
Cleveland	Site 14 Rubble Mound	88	9,750,000	7/76	10/78	$29,000,000 est.
Rocky River	Material barged to Cleveland site	—	—	—	—	—
Lorain	Site 7	58	1,850,000	6/76	7/78	$ 8,323,774
Vermilion	Material barged to Huron site	—	—	—	—	—
Huron	Site 1 Rubble Mound and Steel Piling	63	2,500,000	6/74	12/75	$ 6,655,600
Sandusky	Site selection in abeyance	—	—	—	—	—
Port Clinton	Material acceptable for open-lake dumping	—	—	—	—	—
Toledo	Site 1 Rubble Mound	242	12,900,000	7/74	7/76	$16,878,000

when it will be placed in service to receive dredge material.

PORT CLINTON HARBOR

Results of the March–April 1975 sampling of the harbor sediments by the U.S. Environmental Protection Agency showed that only a small segment of the harbor was polluted. The polluted area is about 500 feet of the channel lying downstream from the lift bridge. The U.S. EPA will permit restricted open-lake disposal of the material. This means that the polluted material will be

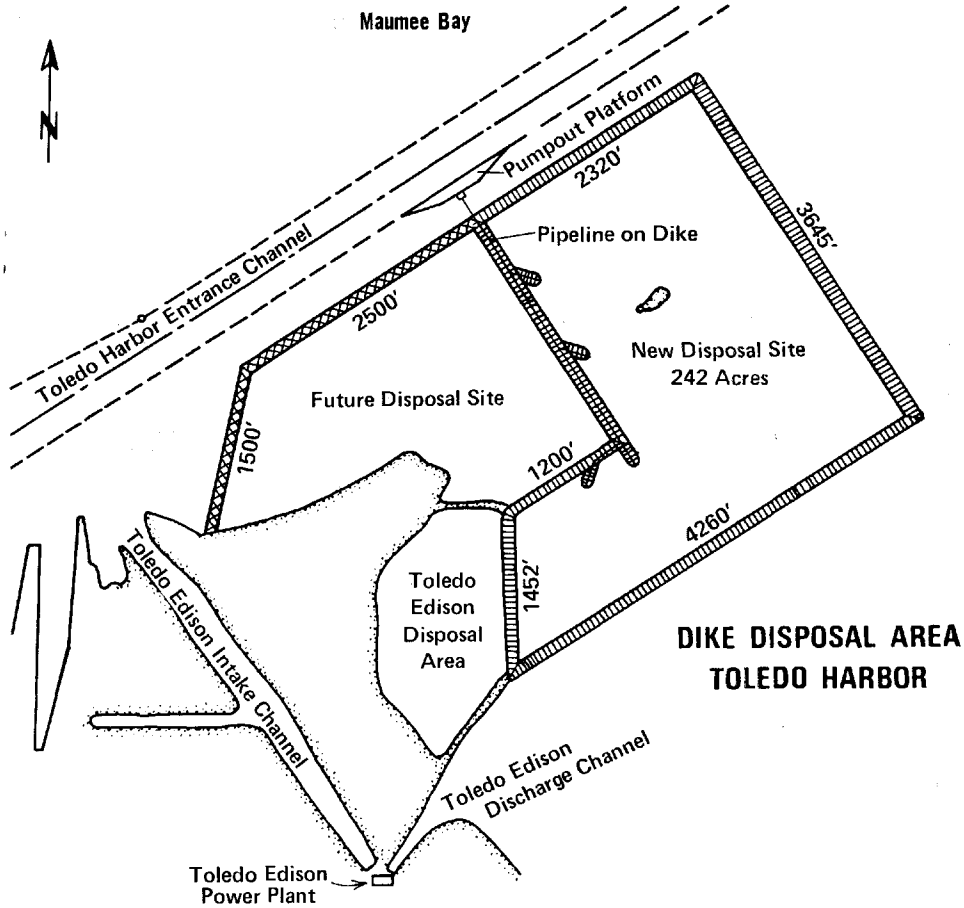
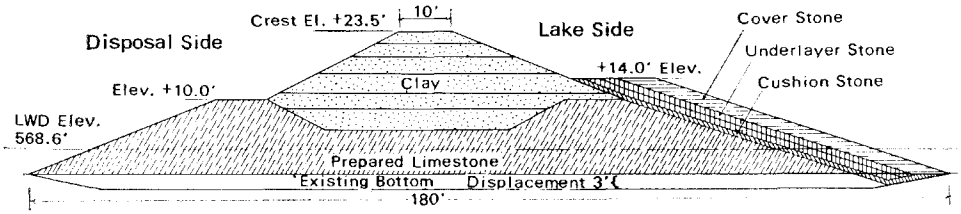


FIGURE 1. Plan view of the Toledo Harbor rubble mound dredge disposal site at the mouth of the Maumee River. The 2.5 miles of dike enclose 242 acres.



TYPICAL RUBBLE MOUND DIKE CROSS SECTION

FIGURE 2. Cross-section of the Toledo Harbor dredge disposal structure.

taken to a designated dumping area and buried under non-polluted dredge spoil material. A confined disposal structure will not be constructed at Port Clinton.

SANDUSKY HARBOR

As a result of the 1975 analysis of Sandusky Harbor sediments the U.S. EPA declared that approximately 60% of the material was polluted. The annual volume of polluted material has been reduced from 500,000 to 300,000 cubic yards. However, a site for the construction of a disposal area satisfactory to local, state and federal interest has not been selected. During the dredging seasons of 1976, 1977, and possibly 1978, polluted dredge material will be transported by barge for disposal at the New Huron Harbor facility.

HURON HARBOR

Construction of the Huron Harbor disposal facility was started in June 1974 and completed at the close of 1975. The structure is located off-shore, adjacent to the west breakwater. It is semi-circular in shape, covering approximately 63 acres (figure 3). This facility with a design capacity of 2.5 million cubic yards will accommodate polluted material dredged from the Huron River navigation channel for a full 10-year period. Some excess capacity, however, will be available to contain polluted material from the Sandusky and Vermilion Harbors. (U.S. Corps Eng., 1976a).

The dike structure, made partially of steel sheet pile cells and partially of rubble mound, will be converted into a recreational facility by the Huron Joint Port Authority following the 10 year filling period. The cost of the project was approximately $6.66 million, all from Federal sources.

VERMILION HARBOR

Maintenance dredging in the Vermilion Harbor is not required on an annual basis. The Corps of Engineers estimate that future maintenance dredging will be required approximately every 3 years and will entail the removal of about 24,000 cubic yards of material during each dredging operation, representing an annual accumulation of 8,000 cubic yards. Recent analysis of the harbor sediments indicate that approximately 60% of the material is unpolluted or marginally polluted and is suitable for open-lake disposal. The polluted sediments will be transported approximately 10 miles to the new Huron Harbor diked disposal facility.

LORAIN HARBOR

Construction for a new dredged material disposal facility for Lorain Harbor (Black River) started in June 1976. It is located off-shore, adjacent to the east breakwater, semi-circular in shape and covering a surface area of 58 acres. The 10 year structure, with a design capacity of 1.85 million cubic yards, will be a rubble mound dike, rising 8 feet above Low Water Datum (Elev. 568.6). After the 10 year filling period the facility will revert to the local cooperator, the Lorain Port Authority, for operation and maintenance. Currently, it is anticipated that after the 10 year filling period a municipal recreation facility will be established on the site. (U.S. Corp Eng., 1976b).

Cost of the structure, approximately $8.3 million, will be paid from the budget of the Corps of Engineers. The U.S. EPA has waived the 25% non-Federal portion of the costs of construction.

ROCKY RIVER HARBOR

Maintenance dredging in the Rocky River Harbor is conducted by the Corps of Engineers only when needed. In 1976, during April and May, approximately 40,000 cubic yards of material were removed from the authorized channel. An additional 26,000 cubic yards will be removed from the West Channel by the Cleveland Yachting Club. Based on sediment sampling in 1975, a major portion of the channel deposits was determined to be polluted and unsuitable for open-lake disposal. The polluted material removed in 1976 was transported by barge for disposal at the Cleveland Diked Disposal Site No. 12.

CLEVELAND HARBOR

A new disposal site has been selected through the cooperative efforts of local,

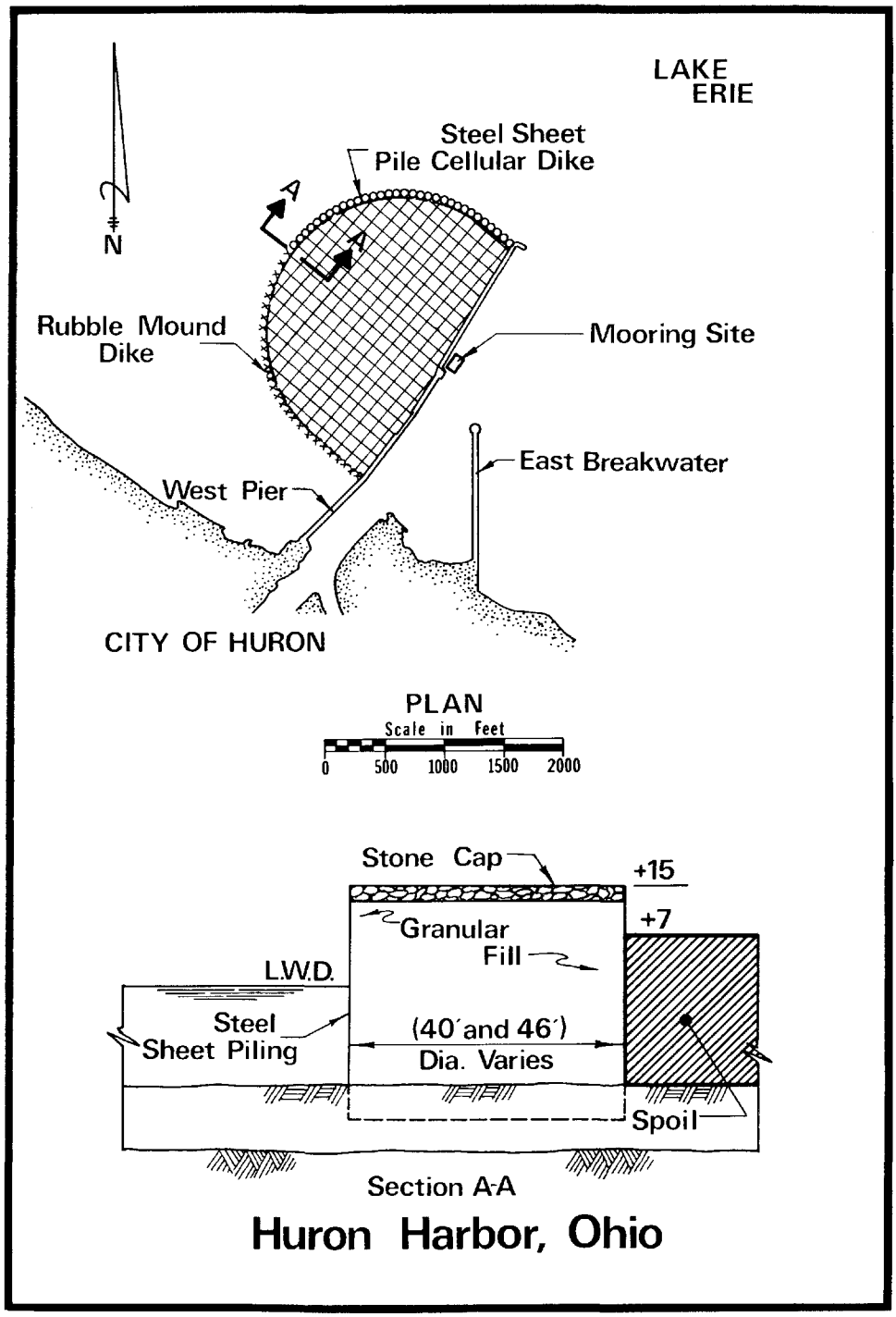


FIGURE 3. Semi-circular disposal facility of 63 acres at Huron Harbor, started June 1974 and finished in 1975. Section AA shows a cross-section of the dike area indicated at the upper left.

state and Federal agencies. Designated as site No. 14, this diked area will occupy 88 acres offshore and adjacent to Gordon Park, located at eastern city limits of Cleveland and west of the Village of Bratenahl. This structure will have a 7 year capacity and, in combination with disposal site No. 12 (a 3 year site completed in 1975) will satisfy the required 10 year capacity for dredged material from the Cuyahoga River navigation channel.

This facility, with a capacity of approximately 6.8 million cubic yards of material, will be a rubble-mound dike costing approximately $29 million. Construction will start during the summer of 1976 with a completion date in late 1978. After the filling period is completed, the facility will be turned over to the City of Cleveland for maintenance and operation as an adjunct to the City's Gordon Park. Upon recommendation of the U.S. EPA, the Corps of Engineers has waived the 25% non-Federal portion of the cost of construction.

FAIRPORT HARBOR

The U.S. EPA and the Corps of Engineers have deferred further work on this harbor project pending resampling of bottom sediments and reevaluation of the laboratory analyses. This came about as the result of the rather spectacular improvement in the character of the sediments during the period 1970 to 1975. A new procedural schedule will be developed when it is determined that a disposal facility is required; otherwise the material will be open-lake dumped at the established designated dumping grounds.

ASHTABULA HARBOR

The latest bottom sediment analysis, made in coordination with the U.S. EPA and the Corps of Engineers in May 1975, resulted in a finding that only about 35% of the dredge material was polluted. About 46,000 cubic yards of the average annual dredging quantity of 129,000 cubic yards require confined disposal. Local, state and Federal interests have not yet agreed on a site for this disposal requirement delaying further progress on the project. Funds for this project were not included in the Federal Budget for Fiscal Year 1977, therefore no further action will occur until 1978 at the earliest.

CONNEAUT HARBOR

The original sampling and laboratory analysis of harbor sediments made in 1969–70 indicated that all of the material in the navigation channel was polluted. Subsequent resampling in the summer of 1974 revealed a marked change in the character of the sediment. Only 10% of the material, about 10,000 cubic yards, was declared polluted and the remaining 90,000 cubic yards were acceptable for open-lake disposal. As a result of this determination, the construction of a designed 52 acre site located adjacent to the east breakwater was cancelled by the Corps of Engineers.

FUTURE

With the completion of the construction of the disposal sites at Cleveland and Lorain in 1978, there is a strong possibility that we have seen the last of such structures in Lake Erie, at least within Ohio waters. The rather spectacular improvement in the character of the sediments at Conneaut, Ashtabula, Fairport and Port Clinton is an indication that the Federal and State pollution abatement programs are effective and that open-lake disposal will be permitted at several of the harbors.

BIBLIOGRAPHY

U.S. Corps of Engineers. 1969. Dredging and Water Quality Problems in the Great Lakes. Volumes 1 to 12. U.S. Corps of Engineers, Buffalo District, Buffalo, New York.

U.S. Corps of Engineers. 1974. Environmental Impact Statement: Maintenance Dredging of the Polluted Sediments in Toledo Harbor. U.S. Corps of Engineers, Detroit District, Detroit, Michigan.

U.S. Corps of Engineers. 1976a. Disposal of Dredged Material: An Environmental Solution. U.S. Corps of Engineers, Buffalo District. Buffalo, New York.

U.S. Corps of Engineers. 1976b. Current Civil Works Projects of the Buffalo District. U.S. Corps of Engineers, Buffalo District. Buffalo, New York.

U.S. Environmental Protection Agency. 1974. Future Dredging Quantities in the Great Lakes. Ecological Research Series. U.S. EPA-460/3-74-029. Page 120.